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SH MUSEUM (NATURAL HISTORY)

THE HOUSE-FLY AS A DANGER TO HEALTH

ITS LIFE-HISTORY
AND
HOW TO DEAL WITH IT

BY

MAJOR E. E. AUSTEN, D.S.O.,
ASSISTANT IN THE DEPARTMENT OF ENTOMOLOGY
BRITISH MUSEUM (NATURAL HISTORY)

THIRD EDITION

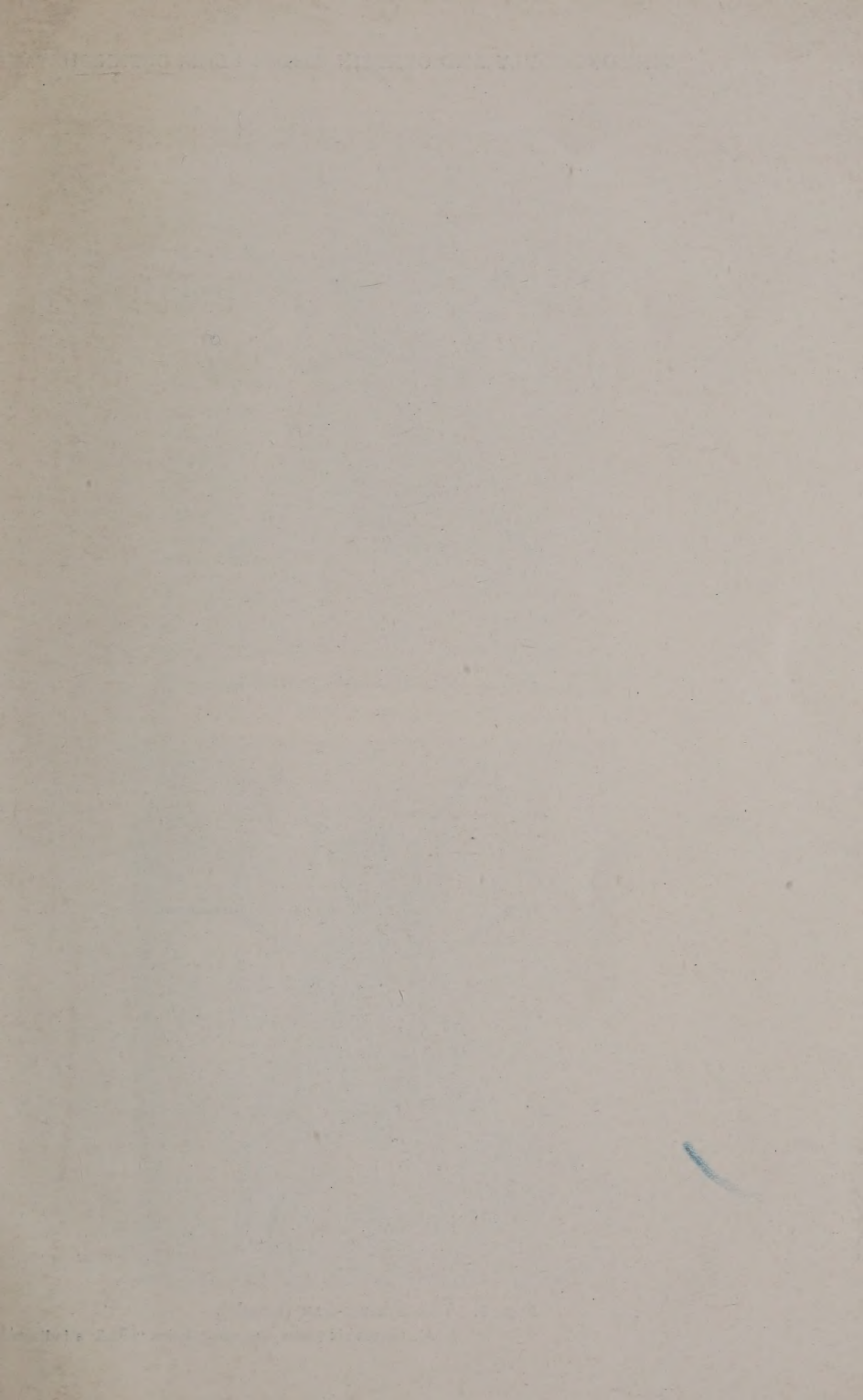


LONDON
PRINTED BY ORDER OF THE TRUSTEES
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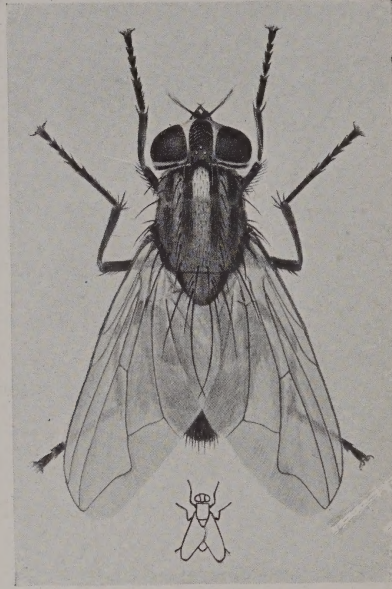


FIG. 1. THE HOUSE-FLY (female).

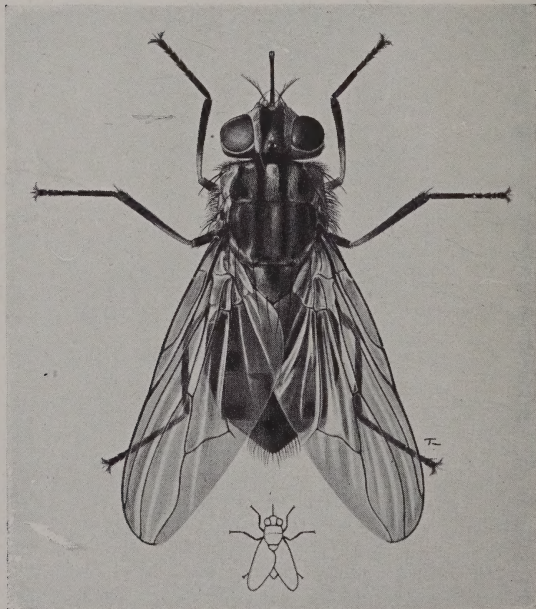


FIG. 4. THE STABLE-FLY (female).

All figures six times the natural size, which is indicated

R IT, OWING TO THEIR FREQUENT OCCURRENCE IN HOUSES.



FIG. 3. *MUSCA AUTUMNALIS* (female).



FIG. 2. THE LESSER HOUSE-FLY (male).

case by the outline drawing below. See also Fig. 5, p. 9.

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BRITISH MUSEUM

SOLD AT

THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, S.W.7,

AND BY

B. QUARITCH, LTD., 11, GRAFTON STREET, NEW BOND STREET, W.1,
AND DULAU & Co., LTD., 34-36, MARGARET STREET, CAVENDISH SQUARE, W.1.

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P R E F A C E.

IN this new edition of Major Austen's pamphlet on "The House-Fly as a Danger to Health," it may be stated that, in its present form, the little work has been enlarged and almost entirely re-written. For several useful suggestions, all of which have been adopted in the text, acknowledgments are due to Lieut.-Colonel S. Monckton Copeman, M.D., F.R.S., of the Ministry of Health, who for many years past has taken an active and prominent part in the investigation of House-Fly problems. This pamphlet is concerned solely with normal conditions in the British Islands; those who desire fuller information covering a wider field, and including the needs of the Army, are referred to the larger pamphlet numbered 1A in this series.

CHARLES J. GAHAN,
Keeper of Entomology.

BRITISH MUSEUM (NATURAL HISTORY).
June, 1920.

THE HOUSE-FLY.*

(*Musca domestica*, L.)—FIGS. 1 AND 11.

THE Common Fly or House-Fly, to which the great Swedish naturalist Linnæus gave the name *Musca domestica* in 1761, is probably the most familiar as it is certainly one of the most widely distributed of all insects. Yet, owing to the fact that several other kinds of flies, more or less resembling it in general appearance, are often found in houses, very few people are capable of recognising a House-Fly with certainty.

Distinctive Characters of the House-Fly, and of certain other Flies Frequently Mistaken For It.

The House-Fly (Figs. 1 and 11), which is normally about a quarter of an inch in length, is mouse-grey in colour, with the thorax (middle part of the body) marked above with four narrow black stripes, and the sides of the abdomen (hinder part of the body) more or less buff in the male, and frequently in the female also. In the male House-Fly the space between the eyes, as seen from above, occupies (in British specimens) between one-fifth and one-fourth of the total width of the head; but in the female the corresponding space is broader, and is equal to nearly one-third of the diameter of the head. As shown in Figs. 1 and 11, the black stripe occupying the centre of the space between the eyes in the female is relatively broad, and is separated from the eye on each side by a much narrower interval. The proboscis, or tube through which the insect sucks up its food, ends in a pair of fleshy

* In the Central Hall of the British Museum (Natural History) the visitor will find enlarged models (twenty-eight times natural size) of the House-Fly, and of its eggs, maggot or larva, and pupa (puparium) or chrysalis, as well as specimens of the actual insect and of certain other flies often found in houses in the British Isles, and liable to be mistaken for it. Representations of a portion of a breeding-place, and of the manner in which the insect pollutes human food are also exhibited.

lobes, and when not in use is folded away into a cavity on the under side of the head, so that it is invisible from above. Lastly, it may be noted that one of the long veins or supporting rods (the so-called *fourth longitudinal vein*) in each wing is, near the tip of the wing, abruptly elbowed in such a way that its end nearly meets that of the vein in front of it (*see Figs.*).

Disregarding the Blow-Fly or Bluebottle (*Calliphora erythrocephala*, Mg.), a pest too well-known to need description, the following are the chief species of flies of which, especially in country districts, specimens often occur in the living rooms of houses, with the result that they are frequently mistaken for the subject of this pamphlet. The Lesser House-Fly (*Fannia canicularis*, L., Fig. 2); *Musca autumnalis*, De. G. (Fig. 3—formerly called *Musca corvina*, Fabr.); the Stable-Fly (*Stomoxys calcitrans*, L., Fig. 4); *Muscina stabulans*, Flin.; and the Cluster-Fly (*Pollenia rudis*, Fabr., Fig. 5).

Reference to Figs. 1 and 2 will show that the Lesser House-Fly (*Fannia canicularis*, L.), as compared with the true House-Fly (*Musca domestica*, L.), is a smaller* and more slenderly built insect, without a conspicuously *elbowed* vein near the tip of each wing. In the resting posture the wings are carried like those of the House-Fly, although they are not quite so wide apart at the tips. The flies frequently seen circling in the centre of a room, playing a sort of aerial kiss-in-the-ring beneath the electrolier or gas-pendant, are seldom if ever true House-Flies, but whenever examined have proved to be specimens of *Fannia canicularis*.

Musca autumnalis (Fig. 3), a species which unfortunately does not possess an English name, although agreeing approximately with the House-Fly in length, is a bulkier, more compactly built and thickset insect, and consequently often appears decidedly larger.

* Specimens of *Fannia canicularis*, and other small flies occasionally met with in houses, are often supposed by those who are not entomologists to be "young" House-Flies. It may therefore be worth while to repeat that, as has frequently been stated before, *House-Flies*, like other insects in the same stage, *do not grow*. Growth, after the insect leaves the egg, is confined to the larval or maggot-stage, and the House-Fly, on passing from the chrysalis-stage to that of the adult, emerges from its pupa-case fully grown. When therefore small flies resembling House-Flies are seen in houses, they are *not* "young" House-Flies in the sense that they will in time grow bigger, but either belong to a distinct and smaller species, or are undersized House-Flies which will never become any larger, their diminutive dimensions being due to unfavourable conditions (generally insufficiency or too great dryness of food) during the maggot-stage.

In the male the upper surface of the abdomen has a black base and central stripe, while the remainder is cinnamon-buff; in the female the upper surface of both thorax and abdomen is grey, with darker markings. To distinguish either male or female of this fly from a House-Fly of the same sex, it is only necessary to examine the upper surface of the head; in the male of *Musca autumnalis* the eyes are so close together as to be almost or actually in contact at one spot, while in the opposite sex the black median stripe is approximately equal in width to the grey border on each side of it. For the distinctive characters exhibited by the head of the House-Fly, see p. 5, and compare Figs. 1, 3 and 11. The resting position of the wings in *Musca autumnalis* is the same as in the House-Fly. In the autumn, in country districts in the British Islands, *Musca autumnalis* frequently enters houses and public buildings, sometimes in large numbers, and subsequently hibernates in attics, roof-lofts, towers, in the folds of curtains in disused rooms, and in similar retreats.

The Stable-Fly (Fig. 4) is a blood-sucking insect, not infrequently responsible for causing its victim to think that he has been bitten by a House-Fly, although the proboscis of the latter is adapted merely for sucking, and is quite incapable of piercing the human skin. While of the same length as the House-Fly, the Stable-Fly is of a somewhat broader and more thickset shape, and may readily be distinguished by the character of its shining black proboscis. This is slender, rigid and non-retractile, and, instead of being folded away out of sight beneath the head when not in action, is *always visible*, projecting like an awl horizontally in front of the head. In colour the Stable-Fly is darkish grey, with the upper surface of the abdomen spotted with dark brown; the terminal portion of the fourth longitudinal vein in each wing, though bent somewhat forwards, is not abruptly elbowed (compare Fig. 4 and Figs. 1 and 11).

Muscina stabulans, another species without an English name, sometimes hibernates in houses or out-buildings, and is, as a rule, of larger dimensions than any of the flies already mentioned, its length often considerably exceeding a quarter of an inch. The general coloration of the body is dark grey, and the abdomen is without definite spots. The extreme tip of the middle part of the body and a portion of each leg are more or less distinctly tinged with cinnamon colour; the proboscis, when not in use, is invisible

from above; and in the wing the end of the fourth longitudinal vein is not elbowed, and converges but slightly towards that of the vein before it. In the resting position the wings are carried like those of *Musca domestica*.

The Cluster-Fly (Fig. 5), which owes its popular name to its habit of clustering together, sometimes in very large numbers like a swarm of bees, when hibernating in houses or other buildings,* may be distinguished, not only from the House-Fly, but also from all the other flies previously mentioned, by the fact that the wings when not in use, instead of diverging at the tips, are closed one over the other like the blades of a pair of scissors (see Fig. 5). Measuring normally about one-third of an inch in length, the Cluster-Fly is, as a rule, a much larger insect than the House-Fly, bulkier and more heavily built, and correspondingly slower and less impulsive in its movements. The upper surface of the dark greyish-olive middle region of the body (thorax) is clothed with a thick coat of fine, silky, recumbent, yellowish- or golden-yellow hair.

A favourite winter retreat of the Cluster-Fly is the interior of the sash-frames and sash-pockets of windows, usually in rooms with a southern aspect, and either unoccupied or only in intermittent use; on warm, sunny days, or when fires are lighted, the flies frequently emerge from their hiding-places and appear on the window panes in sluggish swarms.† Other spots often chosen as winter quarters are beneath loose wall-paper, behind shutters, in the chimneys and ventilators of disused rooms, beneath thatch, and under the slates or tiles on roofs, in the latter case generally in close proximity to a chimney stack in use.

Such are the more conspicuous flies often found in houses in addition to the true House-Fly; the list, which is by no means complete, might be extended by the inclusion of several species, none of which boasts a popular name. The species that hibernate

* In England it frequently happens that swarms of Cluster-Flies, sometimes accompanied by large numbers of *Musca autumnalis* (see pp. 6, 7), take up their abode for the winter in the roofs of churches; on days on which the latter are warmed during winter and spring, the flies cause great annoyance by issuing from their hiding-places and falling to the floor in a semi-comatose condition.

† Although in no way prejudicial to health, these swarms are often a source of annoyance; they are best got rid of by the aid of a domestic vacuum cleaner.

in houses, especially the Cluster-Fly and *Musca autumnalis*, besides being responsible for much popular misconception as to the fate of the House-Fly in winter, often cause annoyance by their presence and numbers, but are not of any importance from



FIG. 5.

THE CLUSTER-FLY (female), six times the natural size.

The latter indicated by the outline drawing below.

a health point of view. Limitations of space render it impossible to deal further with this section of our subject, but it is hoped that enough has been said to enable the more common flies in houses to be differentiated, and to show that *the occurrence*

of a fly inside a house does not necessarily prove it to be a "House-Fly."

Life History of the House-Fly.

Breeding-Places.—These are determined by the needs of the insect in its larval or maggot stage, since the female fly deposits her eggs only in material that will provide food as well as a home for the future maggots. To satisfy the requirements of the latter, a food-material must be capable of being readily swallowed and digested, and must also be *moist* and usually more or less *warm*.

Although in temperate climates, as a general rule and under normal conditions, accumulations of fermenting horse-manure form the chief breeding-places of the House-Fly, it also breeds freely in exposed human faeces, in pigs' dung, and in decaying and fermenting organic matter of various kinds, such as is often present in ashpits and larger deposits of house-refuse. In the case of horse-manure, the material is attractive to egg-laying House-Flies only so long as perfectly fresh, *i.e.* usually at most during the first twenty-four hours. It follows that a manure heap to which no fresh additions are made, but which consists of manure deposited all at the same time, can only produce a single crop of House-Flies, and that, once the flies resulting from eggs laid at the outset have hatched out, no further House-Flies can be bred from it. The apprehensions of those inclined to regard old, and even grass-grown manure-heaps as potential House-Fly breeding-places are therefore devoid of foundation.

Eggs and Egg-Laying.—The glistening white eggs of the House-Fly, which, if examined under a fairly strong hand-lens, in shape and general appearance look very much like tiny grains of polished rice, are about $\frac{1}{25}$ th to $\frac{1}{20}$ th of an inch in length, and are usually laid by the insect one on the top of the other, so as to form small masses (*see* Fig. 6). The latter are generally concealed in crevices in the material that is to supply the maggots with food. Female House-Flies seem to prefer to deposit their eggs in company, and, under suitable conditions, twenty to fifty females may be seen clustered together in a compact group in a hollow on the surface of a fresh manure-heap, all busily ovipositing. Provided that such a collection of flies has been at work for a sufficient time, investigation will sometimes disclose a mass of eggs nearly large enough to fill a small tea-cup. A single female House-Fly lays from 120 to 150 eggs at one time, and may deposit

five or six such batches during its life, so that each female may produce from 600 to 900 eggs. From the laying of the egg, the rate of subsequent development varies greatly, depending upon several factors such as the temperature of the food-material and of the air, and the character of the food. In the British Islands it

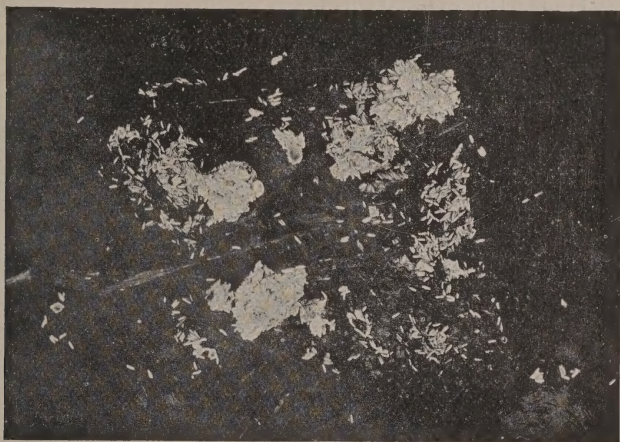


FIG. 6.

BATCHES OF HOUSE-FLY EGGS IN STABLE MANURE (natural size).

Total number of eggs about 1,500.

From a photograph by Professor Robert Newstead, F.R.S., kindly lent by the Health Committee of the City of Liverpool.

has been found that in very hot weather the progeny of a House-Fly may be laying eggs about three weeks after the eggs from which they themselves developed were deposited.

The Maggot, or Larva.—In from eight to twenty-four hours after deposition (when the weather and food-material are warm, though a longer period, up to three days, may elapse if the temperature be lower) the eggs hatch into tiny, white, footless maggots. These burrow into and feed vigorously upon their food-material, grow rapidly, and in very hot weather attain their full development and size, or a length slightly under half an inch (see Figs. 7, 8 and 9), in from about forty-two hours to four or five days. At lower temperatures the maggots require a much longer time, even as much as six to eight weeks, to reach maturity. It

is worth noting that in an infested manure heap House-Fly maggots are not to be found all through the mass, but are confined to a superficial layer usually at most from four to five inches in depth, since, owing to the great heat produced by fermentation, it is impossible for them to exist at a deeper level. An infallible indication of the presence, actual or previous, of mature House-Fly maggots in large numbers in a manure-heap is a characteristic *trituated* or *comminuted* appearance at certain

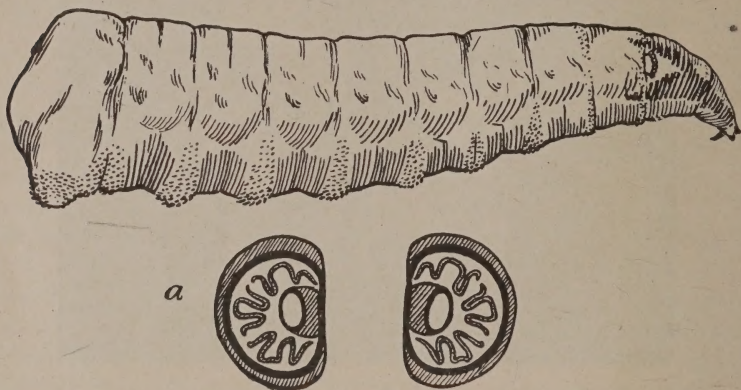


FIG. 7.

FULL-GROWN HOUSE-FLY MAGGOT, OR LARVA (about nine times natural size).

a, the two plates on the hinder extremity of the maggot, showing the deeply folded air-clefts through which the creature breathes (greatly enlarged).

The anterior extremity of the maggot is to the right, the broader end being the posterior one. The maggot crawls, with its narrower end in front, by the aid of a hook (shown in the figure), which is protruded from the mouth, and a series of spiny pads on the under surface of the body. The mouth is situated on the under side, just behind the narrow end, and the maggot, like the parent Fly, feeds upon matter in a fluid condition.

The larvae or maggots of a very large number of other flies are similar in appearance to those of the House-Fly, which, however, can be distinguished from most other larvae by the deeply folded shape of the three air-clefts in the posterior breathing-plates (*a*).

spots, where, owing to the activities of the larvae, the surface has been reduced to the condition of finely chopped straw. The fully-fed maggot, which is about to pass into the pupa- (or chrysalis-) stage, and is recognisable owing to its ivory yellow, *waxy* appearance, leaves the place where it has been feeding, and seeks a drier and cooler spot in which to undergo its transformation. Where the breeding-place is a manure heap, the latter usually takes place outside the base of the pile, either immediately

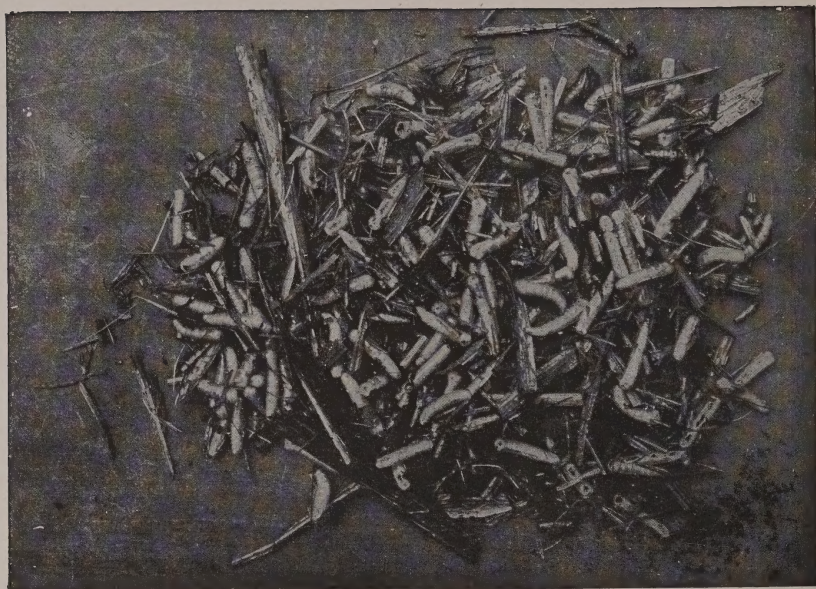


FIG. 8.



FIG. 9.

FIG. 8. A MASS OF HOUSE-FLY MAGGOTS IN STABLE MANURE (natural size).

FIG. 9. THE SAME MAGGOTS SEPARATED FROM THE MANURE.

From photographs by Professor Robert Newstead, F.R.S., kindly lent by the Health Committee of the City of Liverpool.

To face page 13.

under cover of the overhanging straw, or at varying distances, generally up to three or four feet, but occasionally as much as fifty yards from the heap, and at depths beneath the surface of the soil ranging from an inch or so to a couple of feet.

The Pupa, or Chrysalis.—This stage, which succeeds that of the full-grown maggot, is motionless, and lasts according to the temperature for from three to four days to two to four weeks or

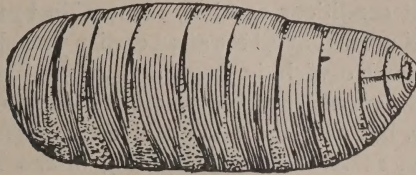


FIG. 10.

HOUSE-FLY PUPARIUM OR CHRYSALIS-CASE (about eight and a half times natural size).

As in all species of flies belonging to the same natural group as the House-Fly, the puparium is formed from the contracted and hardened skin of the full-grown maggot, which serves as a case to contain the pupa or chrysalis. The fly when ready to emerge makes its escape by forcing off the upper and lower surfaces forming the anterior end (to the right in the figure) of the puparium.

more, is passed within a barrel-shaped puparium or shell (Fig. 10), normally about a quarter of an inch in length, which is at first yellow, and becomes successively red, brown, and finally, shortly before the fly is hatched, black.

The Adult Fly.—On hatching from its pupa-case, the House-Fly at first presents little resemblance to the familiar insect known to everyone, since it is lacking in colour and has a wizened and shrunk appearance, while its shrivelled wings are quite incapable of flight. Its escape from the puparium or pupa-case, as also its progress to the surface of the soil in the case of a buried pupa, is effected by means of the alternate expansion and contraction of a temporary dilatable sac or bladder (ptilinum) on the front of its head. Having served its purpose, the frontal sac is withdrawn into the interior of the head and is seen no more; soon afterwards the wings spread out and become capable of flight, the outer covering of the body and legs hardens, and the insect assumes its normal aspect.

From what has been stated in the foregoing pages, it will have been seen that, under very favourable circumstances, a batch of

eggs may develop into House-Flies in from eight to nine days; a further period (in England from fourteen to eighteen days, in the United States often very much shorter) must, however, elapse before these flies are themselves capable of laying eggs.

In the British Islands, the earliest broods of the season usually commence to make their appearance in June, though as a rule it is not until the following month that the numbers of House-Flies begin to show a marked increase. Generally speaking, in the absence of local conditions specially favourable to the breeding of the insects in abnormal numbers at an earlier period than usual (as at Postwick, near Norwich, in June and July, 1910), House-Flies in the United Kingdom are most numerous in the months of August and September, but they are often still common in October, and sometimes even in November. Breeding in the British Islands may be said to cease in October. Not long afterwards as a general rule, except for a few individuals, which continue to exist for a considerable time, *in an active condition*, in bake-houses, kitchens, restaurants and similar specially favourable retreats, House-Flies disappear altogether, and are no more seen until late spring or early summer of the following year. Where and in what stage the House-Fly contrives to survive the winter, so as to perpetuate its species from year to year, is not yet definitely known. In spite of frequent assertion to the contrary, *House-Flies do not appear to hibernate*; on the other hand there is as yet no evidence that the *active* flies, which, as has just been indicated, may still be seen in certain places in late autumn and the earlier months of winter, survive until the following breeding-season.

Large numbers of House-Flies are destroyed every autumn by a parasitic fungus (*Empusa muscae*, Cohn), which is one of the most effective natural enemies of the species. Dead flies killed in this way, with swollen, whitish, dark-banded abdomens, may often be seen clinging to window-panes, walls or shelves, attached to the supporting surface by outgrowths (rhizoids) from the fungus itself, and frequently surrounded by a sort of pale halo composed of fungal spores.

House-Flies and Disease.

The House-Fly is not merely a nuisance, but is also, or under certain conditions is capable of being, a carrier of disease and therefore a very serious *danger to health*. In order that this familiar insect may be regarded in its true light, it is important that everyone should

realise the grounds on which the foregoing statement is based, which are briefly:—

(1) The frequent presence in human faeces of the living germs of certain dangerous diseases, or (especially in warmer climates) of the eggs of various parasitic worms.

(2) The irresistible attraction of human faeces, if exposed or otherwise accessible, for House-Flies, which feed greedily upon this material, and in so doing swallow the disease-germs or eggs (if present) mentioned in (1).



FIG. 11.

HOUSE-FLY (female) IN THE ATTITUDE OF FLIGHT (six times natural size).

(3) The almost equally powerful attraction exerted upon House-Flies by human food, especially milk, sugar, jam, bread, and cheese (all of which are consumed uncooked); the insects may, and under certain circumstances frequently do, pass *directly from faeces to food*.

(4) The fact that the disease-germs and eggs referred to in (1) may pass through the House-Fly unaltered.

(5) The habit of the House-Fly of voiding its liquid excrement, which thus often contains the living causes of disease already alluded to, at frequent intervals, *especially when feeding*. In this way virulent disease-germs may be deposited by House-Flies

directly upon human food (such as is mentioned in (3)), or upon eating or drinking utensils in actual use.*

The diseases that House-Flies, under particular conditions, carry or are capable of carrying include, but are by no means limited to, cholera, summer diarrhoea, typhoid fever, dysentery, and certain maladies caused by parasitic worms, and in the British Islands the activities of the House-Fly are responsible annually for the deaths of large numbers of infants, due to "summer diarrhoea" and resulting from the consumption of fly-contaminated milk. The most superficial observation, coupled with a very little reflection, will suffice to show that, especially in country districts, in the poorer quarters and outskirts of large cities and towns, and in those urban areas where the "midden-privy" system continues, the House-Fly finds many opportunities for evil, and there can be no doubt whatever that it is by far the most important of British insects from the standpoint of public hygiene. Under modern conditions House-Flies, except as "danger-signals," serve no purpose useful to ourselves, while they may at any time develop into a danger to human life. It is therefore the bounden duty of everyone, by the employment of *all possible means*, to assist in protecting the community from the perils inseparable from the presence of these living vehicles of infection.

Preventive Measures and Remedies.

In measures against the House-Fly, whether by the individual householder or public authorities, the best results can be secured only by attacking the pest by every available means; the two following rules, however, should never be lost sight of.

(I) It is far better, by means of timely treatment of possible breeding-places, to prevent House-Flies from breeding, than to permit them to breed unchecked, and then endeavour to kill the resultant broods after they have invaded houses or other habitations.

(II) No system of sanitary control can be regarded as efficient which allows House-Flies to have access to material containing, or possibly containing, the germs of disease.

* Certain disease-germs may also be deposited in the vomit, which the House-Fly uses to liquefy solid food, such as sugar; or they may be carried externally on the insect's legs or other parts of its body. For various reasons, which need not here be specified, however, these modes of disease-carriage by House-Flies are on the whole far less important than that mentioned above.

Prevention of House-Fly breeding in horse-manure.—On removal to the manure-heap or dump, fresh horse-manure, during the fly-breeding season, should be treated either by *close packing* or *turning over the surface*, the object of both methods being to kill House-Fly eggs, maggots or pupae (if present) by subjecting them to the great heat produced by the fermentation of the manure. For *close packing*, an area of hard, level ground is necessary, and should extend several feet each way beyond the intended dump. Each addition of manure must be pressed down firmly with shovels, and sprinkled slightly with water if the weather be dry; the sides of the heap, which must similarly be beaten and smoothed down, should be somewhat sloping. The fertilising value of manure thus treated is greater than that of loosely stacked manure.

When treatment by *turning over the surface* is adopted, the dump should rest on an area similar to that described above, and, though it need not have its surface beaten down, it should be compact and flat-topped; the slope of its sides should not exceed 30 degrees. On the day after deposition and on the two following days, the original dump or each fresh addition should be turned over with spades, in such a manner as to bury the outer layer five or six inches deep, thus exposing maggots, if present, to the almost instantly fatal effects of the heat and gases of fermentation at deeper levels.

The object of the two methods just described may also be attained by covering each fresh addition to the manure heap, for one week, with a layer of sacking (old coal sacks, if without holes, answer well) soaked in heavy oil and secured by means of large stones.

Other practical measures include marking spots where clusters of House-Flies are seen ovipositing (*see* p. 10), and two or three hours later (not longer, lest the eggs should hatch) carefully removing and burning the egg-masses; and trapping adult maggots migrating to spots in which to pupate. A simple form of maggot-trap consists of a large tin box, having in each side a horizontal slit two inches above the bottom and not quite reaching the angles; the slits are wedged open, after which the tin is filled with dry sand or chaff to a height of four inches, and provided with a cover. When full-grown, waxy maggots are discovered in any part of a manure-heap, the spot is surrounded with traps, each of which is sunk in the manure until the slits are just level with the

surface. On the following morning the traps should be examined and the catch burned.

It should be needless to insist that, where stables, slaughter-houses and similar places are situated in populous areas, the greatest care should be exercised both by the owners and by the sanitary authority to ensure (1) the frequent and regular removal of all manure and offal from the area, and (2) the use of satisfactory covered receptacles.

Prevention of breeding in household or kitchen refuse.—Before removal, refuse of this kind should be kept in receptacles which are *really*, and not merely nominally, *fly-proof*. In urban districts, from June to October inclusive, removal should be not less frequent than twice a week, after which a municipal *destructor* affords the best method of disposal. Care must be taken to prevent any accumulation of unburned organic matter in the vicinity of a destructor.

House-Flies have a natural tendency to disperse from their place of origin, and under experimental conditions in the United States are said to have flown to a distance of thirteen miles. When, therefore, in the absence of a destructor, *dumping* of household refuse has perforce to be resorted to, no municipal dépôt contractor's dumping ground or "tip," where the material is allowed permanently to remain, should, if any other arrangement be possible, be established or permitted to exist within at least a mile of the nearest habitations.

Methods of destroying House-Flies.—For ordinary household purposes, these include the use of:—traps; sticky fly-papers ("tanglefoot"); fly-poisons; spraying fluids; and "fly-killers."

The glass *bell-trap* (baited with a mixture of sugar and beer) and the "*fly-balloon*" of wire-gauze (baited with anything attracting flies at the time, or with a paste made of equal parts of sugar and cheese, moistened with water) are both efficient, and are too well-known to need description. To kill flies in a balloon trap the latter should be placed for a minute or so in a hot oven.

For use during the day, *sticky fly-papers* in the form of sheets are generally preferable to narrow strips, and are said to be most effective when curved into the shape of an arch. Tanglefoot mixture, for coating sheets of *glazed* paper, or lengths of stout wire for suspension, can be made by weighing out five parts of castor oil and eight parts of powdered resin, and heating the two

together (without boiling) until the resin is entirely dissolved. The mixture, which may be kept indefinitely in a closed tin, should be applied as thinly as possible while hot, or after being heated, to the surfaces to be coated.

A very effective *fly-poison* can be made by mixing two teaspoonfuls of commercial (40 per cent.) formalin, and two heaped table-spoonfuls of sugar, with lime water to make up one pint. One or two layers of blotting-paper, or pads of cotton wool, damped with this fluid, may be exposed in soup plates; or the liquid may be placed in closed tins with perforated lids, through which are passed wicks, having their lower ends dipping into the fluid. Formalin mixture generally works best in the early morning, but whenever used care must be taken to ensure that *no other sources of fluid refreshment are accessible* to the intended victims. Since formalin is poisonous to human beings, the mixture must be used with caution and due safeguards against interference by children. Another fly-poison is prepared as follows. Dissolve three teaspoonfuls of powdered sodium salicylate in a pint of water, and nearly fill a tumbler with the solution; over the tumbler place a circular piece of blotting-paper somewhat larger in diameter, and over this an inverted saucer. Turn the whole device upside down, and insert a match under the edge of the tumbler to permit the access of air. The blotting-paper, upon which a little sugar should be sprinkled, will keep moist until the liquid is exhausted. In a closed room fresh pyrethrum powder, distributed by being shaken from a little muslin bag until the air becomes distinctly foggy, will poison all imprisoned flies; though not harmful to man, this powder is somewhat irritating to the nose and throat when inhaled. Another method of using pyrethrum powder is to bring a candle flame into contact with the under side of the lid of a tin, upon which a small quantity of the powder is heaped; the fumes thus produced stupefy flies unable to escape, and the insects after falling to the ground can be swept up and destroyed.

Various *spraying fluids* for the destruction of House-Flies are obtainable from chemists and stores. These fluids, which generally consist essentially of extract of pyrethrum powder, have to be diluted with water before being used in a sprayer, and are not effective against flies unless the insects are thoroughly wetted.

Racquets of flexible wire gauze mounted on wooden handles,

or consisting of disks of soft leather provided with handles of wood or wire, are known as "*fly-killers*," and in capable hands amply justify their name. Of the two patterns, the former (generally obtainable from ironmongers) is preferable, especially if the edges of the racquet be bound in such a way as not to fray.

General Precautions.—House-Flies may be excluded from sheds, marquees and similar structures by protecting each door or other opening with a net (ordinary fishing net, with a mesh of about $\frac{3}{4}$ inch), through which, provided it be without holes, the insects will not pass. In the case of doorways, the net must of course reach to the ground, and care must be taken to see that it is nowhere caught up.

Larders, for the storage of cold cooked food and food intended to be consumed uncooked, *must* always be fly-proof, and eating and drinking utensils (including plates, glasses, cups, knives, forks and spoons) after being cleansed must be kept under similar cover.

When House-Flies are present at meal-times, all food, including jugs of milk or other liquids, set out on tables should be protected by fly-proof covers. These may be either wire frames covered with wire gauze or mosquito netting, or squares of muslin weighted along the edges.

In hospital wards and similar places, House-Flies should not be allowed to settle upon persons suffering from infectious or contagious diseases. Rigorous precautions should, of course, be taken to prevent House-Flies from coming into contact with the sputa of consumptives, or with the evacuations from cases of cholera, typhoid fever, dysentery and summer diarrhœa.

Note.—The foregoing pages are concerned solely with House-Flies in the British Islands. Those who desire fuller information upon the subject of House-Flies, with details of preventive measures against these insects for the use of **troops in the field** as well as of civil communities, should consult:—British Museum (Natural History) Economic Series No. 1A. "*The House-Fly, its Life-History and Practical Measures for its Suppression.*" By Major E. E. Austen, D.S.O., London: Printed by Order of the Trustees of the British Museum. 1920. 52 pp., 11 figs. Price 1s. 6d.

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- No. 1.—**The House-Fly as a Danger to Health.** Its Life-history, and how to deal with it. By Major E. E. Austen, D.S.O. Third Edition. Pp. 20: 3 plates (containing 6 figures), and 5 figures in text. 1920, 8vo. 3d. (*postage 1½d.*).
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- No. 3.—**Fleas as a Menace to Man and Domestic Animals.** Their Life-history, Habits, and Control. By James Waterston, B.D., B.Sc. Second Edition. Pp. 21: 1 plate and 6 text-figures. 1920, 8vo. 4d. (*postage 1½d.*).
- No. 4.—**Mosquitoes and their Relation to Disease.** Their Life-history, Habits, and Control. By F. W. Edwards, B.A. Second Edition. Pp. 20: 6 text-figures. 1920, 8vo. 4d. (*postage 1½d.*).
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- A pamphlet on "**The Furniture Beetle**" is in preparation.

ECONOMIC LEAFLETS.

- No. 1.—**The Danger of Disease from Flies and Lice.** Second Edition. Pp. 4. 1918, 8vo. Price: 1d. for 3 copies (*postage 1d.*), 2s. 6d. for 100 (*postage 5½d.*).
- A leaflet on "**The Danger of Disease from Fleas and Bugs**" is in preparation.

Applications to the Museum direct for any of these pamphlets should be accompanied by a remittance, including postage.

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